Renewable Energy Systems
Turbine Air Systems
Modular Utility Systems
Modular Data Centers

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California Energy Commission Docket No. 12-IEP-1D Lead Commissioner Workshop on Renewable Integration Costs, Requirements, and Technologies

TAS Energy (TAS) appreciated the opportunity to serve on the panel addressing gas-fired generation assets at the California Energy Commission's (CEC) 2012 Integrated Energy Policy Report (IEPR) workshop covering renewable integration. We further appreciate the opportunity to submit formal written comments to the questions proposed which will be covered in the CEC's 2012 Integrated Policy Report Update.

TAS Energy is a technology company based in Houston, Texas which manufactures clean energy equipment, including a chilling and storage solution for gas turbines called Generation Storage. With about half of its generation coming from natural gas-fired sources,[1] California has over 1,200 megawatts of flexible capacity that can be recovered through retrofitting current combined cycle gas turbines. These megawatts begin to be lost, and thereby recovered through chilling, when temperatures increase above the design temperature. In these comments we specifically answer four of the many questions outlined.

(1) What engineering improvements have been made to increase the flexibility of gas-fired generation resources during the past decade?

Generation Storage is one example of improvements that have been made to increase the flexibility of gas-fired generation resources in the past decade. Generation Storage is the evolution of turbine inlet chilling, a proven technology that has been installed on over 400 turbines worldwide, and was first installed on a peaking facility in Bakersfield, California in the 1980's. Turbine inlet chilling uses chilled water to chill the inlet air of a gas turbine to recover the megawatts that are lost to temperature derate. Megawatts lost to temperature derate are identified in discussions of net qualifying capacity (NQC). The NQC of a gas turbine is substantially lower as outside temperatures increase. At the end of this question is a graph that charts the output capacity decrease according to temperature. The technology operates much like an air conditioning, allowing the gas turbine to operate at its full net qualifying capacity potential, despite the hot weather—just as a residential air conditioner creates cooler inside temperatures despite the warm outside weather.

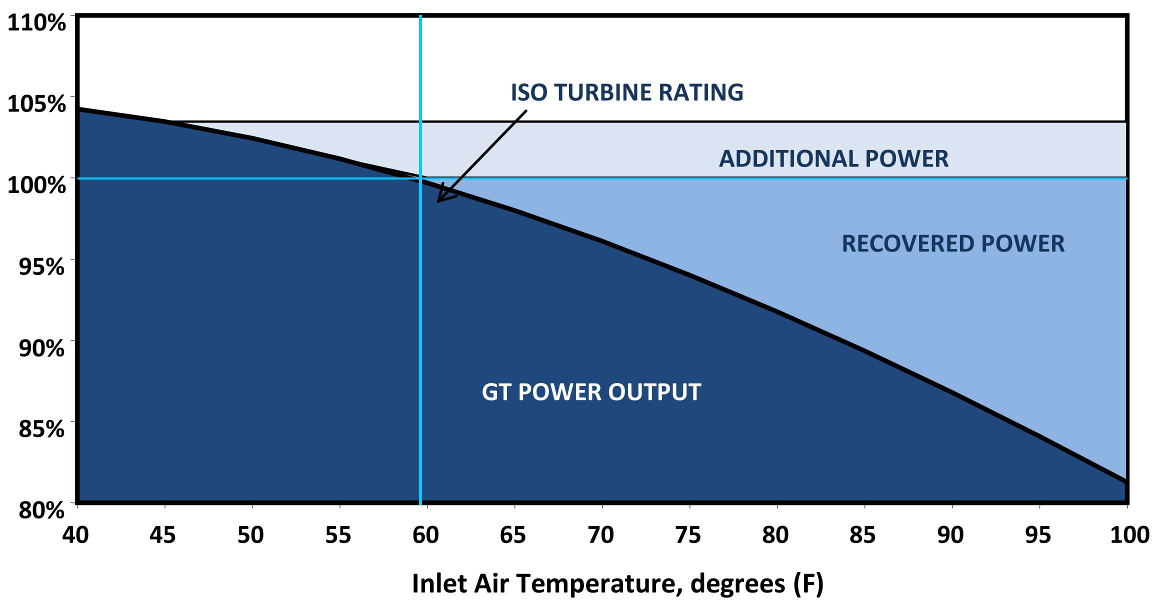
[1] Source: California Energy Commission (2011)
*Another form of inlet cooling that has been in use for decades includes evaporative coolers (fogging), however this technology does not utilize chilled water, and thus cannot benefit from the addition of a thermal energy storage tank. See TAS Energy white paper comparing inlet cooling technologies. Paper attached and linked.

While turbine inlet chilling provides an opportunity to recover megawatts lost to temperature derate (increased capacity), the addition of a thermal energy storage tank provides *flexible* megawatts through a simple pump adjustment governing the amount of chilled water that flows out of the tank to chill the inlet air. With a larger amount and/or lower temperature of chilled water, the capacity can 'ramp up' to its fullest amount, or subsequently ramp down to merely a few megawatts in under two minutes, according to grid need.

Generation Storage can be designed to operate in many ways, however a typical design and operation would allow for electricity to be used to chill water at night off-peak hours when prices are lower according to lower demand, and stored in a thermal energy storage tank. The following day, when prices are higher and the grid is in need of flexible capacity, the chilled water can be released from the tank to flow over the inlet air of the turbine thereby increasing its output. By simply changing the speed of the pump controlling the chilled water flow, the turbine or grid operator has complete control over the increase and decrease in the output. In under two minutes the megawatts recovered by the addition of the Generation Storage technology can increase or decrease according to grid need. On a typical 2x GE 7FA combined cycle, which generates 550 MWs, at the standard design temperature, could recover about 27.5 MWs when outside temperatures are around 75 degrees F and 82 MWs when outside temperatures are around 90 degrees F.

Generation Storage can also offer the grid an off-peak load sink through the electricity used for charging the thermal battery. Again using the typical 2x GE 7FA combined cycle, the tank is typically sized such that it requires about 10 MWs of power to chill all of the water, or said another way; the tank battery is fully charged utilizing 10 MWs of power. The 10 MWs can be supplied by station power to assist keeping a combined cycle online when grid demand is low, or can be supplied by variable renewable resources that ramp up at off-peak hours unexpectedly, the tank serving as a load sink.

The storage tank has been added to the fundamental turbine inlet chilling technology in wide-scale commercial deployment in the last decade, but itself is a proven solution commonly used by commercial customers interested in managing their air conditioning load. It is cost effective and well insulated, losing less than 1% of its stored energy per week.



* The y axis displays the percentage output of its designed capacity

Which specific operating characteristics does/should natural gas-fired generation have in order to provide the ancillary services needed to integrate variable energy resources in terms of response time, ramp rate, reliability, incremental costs?

Because all gas turbines lose capacity as temperatures rise, and because one of the solutions to this problem, chilling with storage, provides flexible and instant regulation up and down capabilities to assist with renewable integration, and because the cost is 1/3 the cost of building a traditional simple cycle unit, the California Energy Commission and its sister agencies ought to encourage in reports such as the IEPR, that retrofits to existing combined cycle gas fired generation be considered before considering the addition of any new generation resources, especially simple cycle 'peaking' units. As mentioned earlier in these comments, hidden within California's own combined cycle gas-fired fleet is about 1,200 MWs of flexible capacity. This capacity would be generated at the combined cycle's heat rate, providing a much better emissions profile than considering the construction of a new simple cycle peaking unit.

The addition of the storage tank provides distributed, small sized off-peak load sinks located at each generation station to assist in responding to unexpected ramping of intermittent wind generation. The installed cost per kw generated is about $350-$400 on retrofitted assets (only $250-$350/kw on greenfield projects), roughly 1/3 the cost of a traditional peaking unit valued at approximately $1,100/kw[2]. Generation Storage also requires no new transmission.

(3) How do we deploy thousands of MWs of energy storage within the next 5 and 10 years respectively?

Certainly the work being undertaken by the California Public Utility Commission in the Resource Adequacy and Long Term Procurement Proceedings to evaluate the need for, and value of flexible capacity will have a significant impact on providing cost recovery solutions for deploying technologies including energy storage. As has been suggested in several comments such as those by Pacific Gas & Electric, and Southern California Edison, the establishment of multi-year forward procurement contracts is essential to financing these and other assets.

Generation Storage technology can complete construction and installation in under one year, typically around 9 months from contract to online date. With over 1,200 MWs able to be recovered from California's current combined cycle fleet, Generation Storage and other similar technologies could quite possibly provide the first thousand megwatts needed. However, retrofits to existing combined cycle assets face unique challenges under the current procurement structure. Facilities already under contract are unwilling to risk problems that could arise by re-opening a contract. Furthermore, comments from both the independent power producer and the utility communities suggest that long term procurement contracts are assumed to be, or truly are intended for 'new steel in the ground,' not to include new steel used to retrofit existing assets ('old steel'). All Request for Offers, whether they be for long term procurement, or resource adequacy needs ought to explicitly state the eligibility of retrofits to existing assets. The Public Utility Commission should even consider encouraging 'retrofit only' Request for Offers according to grid needs. Generation Storage can provide the same level of added flexibility as traditional simple cycle

[2] Example: CPV's Sentinel Project for Riverside County

plants for 1/3 the cost at combined cycle efficiency and emissions levels.[3] This technology and other retrofits ought to be considered before the permitting and construction of new assets.

Furthermore, to address the concern of re-opening contracts to account for the added value of recovered capacity through the investment in technologies such as Generation Storage (among others), an 'over-lay' contract option ought to be created. An 'over-lay' contract can be executed on top of existing bilateral agreements to account only for the investment made for retrofit improvements to existing assets.

We believe over 1,200 MWs of flexible capacity can be added to the California grid in less than 5 years' time with a cost lower than the conventional approach of new simple cycle units through making the best use of current assets while assuming zero technology risk. This chilling and storage technology can also be added to facilities expected to be repowered under the new Once Through Cooling law (and other greenfield projects), ensuring future assets are as flexible as possible with the lowest cost to rate payers. In order to see these advancements in California's current gas fleet, regulator attention and action is needed.

(4) Are there recent examples of energy storage systems that have successfully addressed the small-scale or large-scale photovoltaic (PV) integration and/or wind resource integration issues?

The ERCOT and PJM markets have examples of Generation Storage facilities utilized for both added peak capacity, as well as added *flexible* capacity to manage integrating renewables.

An ERCOT cooperative currently operates a Generation Storage facility on their combined cycle which supplies an additional 92 MWs to the community. The owners considered installing the more common turbine inlet cooling technology, evaporative cooling, but learned Generation Storage would provide them with a far higher number of added MWs *with flexibility* to utilize the peak and off-peak periods for better grid responsiveness, and therefore a higher return on their investment.

The PJM's forward capacity market provides an opportunity for asset owners to bid in their extra capacity for use when needed. TAS Energy is currently constructing the world's largest Generation Storage system for a Dominion Power owned combined cycle in North Carolina. The Generation Storage system will provide nearly 200 MWs of recovered power from the asset.

Generation Storage is one of example of a technology that can be included in new greenfield projects, and added to existing combined cycles to provide greater flexibility for the California grid. Recognition of the environmental value, and low cost to rate-payers of investing in retrofits rather than building new units is a good first step towards scaling up the grid. These types of technologies can and should also be included in any new facilities deemed approved for rate basing and construction by the Commissions. California is leading the nation, and in many cases the world in creating an advanced, clean, efficient grid. In order to do so successfully, it is essential that California get the most from its former and future investments, including capacity, flexibility, low environmental profile, and lowest cost. Generation Storage is a good example of one such technology to help achieve these goals.

[3] Generation Storage produces these megawatts as temperatures rise from 59 degrees F and higher, providing about 5 % of the turbine's nameplate capacity when temperatures are around 75 degrees F and about 15% of the turbine's capacity when temperatures reach the 90's.

TAS Energy looks forward to continuing to comment in these and many other important ongoing discussions. We thank you for the opportunity to do so.

Sincerely,

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